SP-F3.1 Evaluation of Project Effects on Fish and Their Habitat within Lake Oroville, its Upstream Tributaries, the Thermalito Complex, and the Oroville Wildlife Area

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1.0 Introduction/Background

The fisheries in Lake Oroville, its upstream tributaries, the Thermalito Complex waters and the Oroville Wildlife Area ponds are different from the downstream fishery in the main channel of the Feather River for several reasons. The fisheries in this plan (SP-F3.1) differ from the fishery in the main channel of the Feather River because the water bodies in SP-F3.1 are largely artificial environments which are managed for different sets of objectives and different resources than the downstream fishery. Because the management objectives and resources differ, management practices utilized in the water bodies addressed in SP-F3.1 differ from those utilized in the main channel of the Feather River. Additionally, the habitat in Lake Oroville, its upstream tributaries to the high water mark, the Thermalito Complex waters and the Oroville Wildlife Area (OWA) ponds is largely lentic, or lake-like, in contrast with the downstream fishery which consists of lotic, or riverine, habitat. As a result of the differences in fisheries resources, management objectives, and habitat, the evaluation of potential project effects on upstream fisheries will be necessarily different from evaluations of potential project effects on the downstream fishery.

Not only do the fisheries addressed in SP-F3.1 differ collectively from the fishery in the main channel of the Feather River for the reasons described above, but the individual fisheries described in SP-F3.1 differ from each other in several ways. Within each geographic area covered in SP-F3.1, management goals, fish species, and fish habitat differ. Additionally, project operations affect each area differently. For example, water surface elevation fluctuations in Lake Oroville take place on a seasonal scale, whereas the water surface elevation fluctuations in the Thermalito Afterbay may take place on a weekly or daily scale, depending on power generation and pump-back operations. There is very little water surface elevation fluctuation in portions of the OWA and in the Thermalito Forebay. As a result of differences in resources, project operations, and fisheries management in each area, each geographic area will be evaluated in ~~a~~ separate tasks as follows: Lake Oroville's upstream tributaries (Task 1), Lake Oroville (Task 2), the Thermalito Diversion Pool and Thermalito Forebay (Task 3), the Thermalito Afterbay (Task 4), and the Oroville Wildlife Area (Task 5).

SP-F3.1 is designed to collect and compile baseline information characterizing the fish species composition and habitat in each geographic area. Because each geographic area has different resources and management goals, detailed background information regarding fish species composition, fish habitat, and management practices for each geographic area will be provided in the task introduction for each area. Evaluations in each geographic area will focus on a defined set of fish of primary management concern. See section 5.0, General Approach, for specific information regarding fish of primary management concern in each geographic area. Each task includes an introduction describing the fish species and habitat in the geographic area, and a description of the literature reviews and data collection required to achieve the task objective. In some cases, the baseline data collected by this plan will be used to analyze potential project effects in SP-F3.1. In other cases, the data collected in SP-F 3.1 will be collected to support specific analyses in related study plans (for example, SP-F5 and SP-F8) and will serve as a foundation for future evaluations and development of potential future protection, mitigation and enhancement measures (PM&Es).

2.0 Study Objectives

The study plan objective is to collect and compile baseline information characterizing the fish species composition and habitat in each geographic area. SP-F3.1 is designed to serve as a repository for the fish habitat and species composition data for the study area. As mentioned earlier, in some geographic areas, the baseline data collected by this plan will be incorporated into an evaluation of potential project effects in SP-F3.1, while in other geographic areas, the data collected in SP-F 3.1 will ~~be used to~~ support specific analyses in related study plans (for example, SP-F5, SP-F8 and SP-F15). Additionally, SP-F3.1 will establish tools to evaluate future potential operational scenarios and for future evaluations and development of potential ~~other protection, mitigation and enhancement measures (~~PM&Es~~)~~.

Individual task objectives include:

- Identify upstream migration barriers (Task 1A);
- Describe fish species composition in Lake Oroville's upstream tributaries (Task 1B);
- Characterize fish habitat in Lake Oroville's upstream tributaries from Lake Oroville's high water mark to the identified migration barrier (Task 1C);
- Describe fish species composition in Lake Oroville (Task 2A);
- Evaluate coldwater pool availability in Lake Oroville (Task 2B);
- Evaluate the impacts of water surface elevation reductions on bass nests in Lake Oroville (Task 2C);
- Review management practices and monitoring studies of sturgeon from reservoirs actively managed for sturgeon (Task 2D);
- Describe fish species composition in the Thermalito Diversion Pool and Thermalito Forebay (Task 3A);
- Characterize fish habitat in the Thermalito Diversion Pool and Thermalito Forebay (Task 3B);
- Describe project operations influencing the Thermalito Diversion Pool and Thermalito Forebay (Task 3C);
- Describe fish species composition and evaluate juvenile bass recruitment in the Thermalito Afterbay (Task 4A);
- Characterize cold water pool availability in the Thermalito Afterbay (Task 4B);
- Characterize inundated littoral habitat and evaluate effects of fluctuations on bass nest dewatering (Task 4C);
- Describe fish species composition in One-mile pond (Task 5A); and
- Characterize fish h~~H~~abitat in One-mile pond (Task 5B).

3.0 Relationship to Relicensing/Need for Study

This study is needed because on-going project operations affect water surface elevations, fish habitat, water temperature and other factors influencing warmwater and coldwater fish populations. Because Lake Oroville's warmwater species primarily use the warm upper layer of the reservoir and nearshore littoral habitats throughout most of the year (DWR 2001), seasonal changes in reservoir storage, water surface elevation, and the rate of change in water surface elevation can directly affect the reservoir's warmwater fish resources. Changes in water surface elevations can affect the availability of nearshore littoral habitats used by warmwater fish for spawning and rearing, therefore affecting spawning and rearing success and subsequent year-class strength. In addition, decreases in reservoir water surface elevation during the primary period for warmwater fish nest-building and spawning may result in reduced initial year-class strength through fish nest abandonment (and subsequent egg and larval mortality due to suffocation and predation) and exposure to desiccation. Positive effects may also be associated with reservoir fluctuations. For example, low reservoir levels may cause concentration of adult fish and forage fish because of the decrease in the total water volume, possibly resulting in adult fish with increased condition factor. Additionally, aquatic weed growth can be controlled with surface waterwater surface fluctuations, and without these fluctuations, excessive aquatic plant growth may limit the amount of forgeable fish habitat. Lake Oroville's coldwater fishery is not self-sustaining, possibly due to insufficient spawning and rearing habitat in the reservoir and accessible tributaries, and natural and artificial barriers to migration into the upstream tributaries with sufficient spawning and rearing habitat (DWR 2001). Project operations potentially influence the ability of salmonids to access upstream tributaries and potentially influence habitat conditions in accessible tributaries. In order to determine potential project effects, it is necessary to inventory and assess the condition of upstream habitat for coldwater salmonids. This study is needed to collect and compile the baseline information regarding fish species composition and habitat in Lake Oroville and its upstream tributaries in order to evaluate potential project effects and to provide a foundation for future evaluations and development of ~~future~~ potential PM&Es.

Changes in flow rates, direction, and water surface elevation resulting from project operations potentially affect habitat availability and water temperatures in the Thermalito Afterbay. The shallow nature of the Thermalito Afterbay results in obvious fluctuation effects with only a few feet of water surface elevation changes (DWR 2001). As a result, mudflats can be exposed and a significant amount of the littoral zone may be dewatered (DWR 2001), thereby affecting the quantity of available habitat in the Thermalito Afterbay. However, as mentioned previously, the ~~surface water~~water surface level fluctuations help prevent excess aquatic weed growth that could result in decreasing the amount of forgeable habitat for fish. Additionally, the Thermalito Afterbay constitutes the most hydrologically complex regime of all of the Oroville Facilities' reservoirs (DWR 2001). The Thermalito Afterbay stratifies thermally in the summer, and therefore may provide habitat for both coldwater and warmwater fish. Changes in Thermalito Afterbay water storage during this period could affect the reservoir's volume and subsequently affect the quantity of habitat available to fish species. Additionally, both the Thermalito Diversion Pool and The Thermalito Forebay support coldwater fish including rainbow trout, brook trout, brown trout, and chinook salmon. Water temperatures in the Diversion Pool and Forebay are potentially influenced by project operations. Therefore, it is necessary to collect and compile the baseline information regarding fish species composition and habitat in the Thermalito Complex waters in order to evaluate potential project effects and to provide a foundation for future evaluations and development of ~~future~~ potential PM&Es.

The OWA ponds are replenished, in part, by the Feather River, which seeps through the porous levees and substrates, or floods into the OWA, during high flow events. Because the stage of the Feather River is controlled by project operations, it is necessary to evaluate fish and their habitat in the OWA in order to assess potential project impacts and provide a baseline ~~from which to evaluate~~for future evaluations and development of potential PM&Es.

Section 4.51(f)(3) of 18 CFR requires reporting of certain types of information in the FERC Application for License for major hydropower projects, including a discussion of the fish, wildlife and botanical resources in the vicinity of the project. The discussion needs to identify the potential impacts of the on-going project on these resources, including a description of any anticipated continuing impact for on-going and future operations of the project. In addition to fulfilling these requirements, information developed in this study plan also may be used for future evaluations and development of potential ~~in determining appropriate~~ PM&Es or other management actions for the project.

4.0 Study Area

The proposed study area includes Lake Oroville, its upstream tributaries, the Thermalito Complex and the OWA. The area encompassed by Lake Oroville includes areas within the fluctuation zone of Lake Oroville to the high water mark. The upstream tributaries of Lake Oroville consist of four major tributaries: the North Fork Feather River, the West Branch of the North Fork Feather River, the Middle Fork Feather River, and the South Fork Feather River. The upstream extent of the study area extends to the first stream channel obstructions that limit~~s~~ upstream migration of salmonids. ~~The upstream migration barriers on the tributaries will be definitively identified in Task 1A.~~ A previous investigation of tributary spawning potential has identified Miocene Dam on the West Branch of the North Fork Feather River, Curtain Falls on the Middle Fork Feather River, and Ponderosa Diversion Dam on the South Fork Feather River as impassable fish barriers, and Big Bend Dam on the North Fork Feather River as an impediment to upstream passage at all but the highest reservoir levels (DWR 1993). These barriers will be re-evaluated under Task 1A and documented to confirm the upper extent of the geographic scope of these and other study plans covering these areas (SP-F8, SP-F15, SP-F5/7, and SP-F2). Smaller tributaries (2nd order or larger) in the study area ~~will~~ to be evaluated in Task 1 ~~and~~ include Berry Creek, Canyon Creek, Chino Creek, Concow Creek, Fall River, French Creek, Frey Creek, Sucker Run Creek, McCabe Creek, and Stony Creek.

Within the Thermalito Complex, the study area specifically includes the Thermalito Diversion Pool, Thermalito Afterbay, and Thermalito Forebay. The region extending from the Thermalito Diversion Dam to the Fish Barrier Dam, known as the Fish Barrier Pool, will be evaluated in SP-F3.2 and therefore is not included in the study area of SP-F3.1. Additionally, the ponds of the Oroville Wildlife Area will be included in the study. The OWA is included in this plan because the fisheries resources and management are more similar to those of Lake Oroville and the Thermalito Complex than to those of the main channel of the Feather River.

Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

5.0 General Approach

This study is designed to collect and summarize information regarding fish species composition and fish habitat within the study area,, and to either evaluate potential project effects on fish and their habitat within SP-F3.1 or to present the findings to related study plans for specific analyses. Although it is recognized that all fish in the study area fulfill an ecological role and that this review may include many fish species in the study area, the tasks in this plan will focus on fish species of primary management concern listed below and any additional fish specifically named in each task. Each geographic area will have a defined set of fish species of primary management concern based on the types of fish each area supports and the habitats present in each area. This study plan is divided into five primary tasks, with each task investigating the fish species composition and fish habitat in a specific geographic area. The fish of primary management concern in Lake Oroville (Task 2) and the Thermalito Afterbay (Task 4) include both warmwater and coldwater species. The evaluation of potential project effects on warmwater fisheries will focus on the bass species that dominate the sport fishery, while the evaluation of potential project effects on the coldwater fisheries will focus on salmonids including chinook salmon, coho salmon, brown trout, rainbow trout, and brook trout. The fish of primary management concern in the upstream tributaries of Lake Oroville (Task 1), the Thermalito Diversion Pool (Task 3), and the Thermalito Forebay (Task 3) include coldwater salmonids such as chinook salmon, coho salmon, brown trout, rainbow trout, and brook trout. In the OWA ponds (Task 5), the fish of primary management concern are warmwater fish, specifically bass species contributing to the sport fishery. The use of the term “fish” in this study plan is used with the knowledge that although many fish residing in the study area may be included, the focus of this plan is on fish of primary management concern. For additional discussion of the fish resources and habitat associated with each geographic area, see the introduction to the task targeting that geographic area.

In order to achieve task objectives including describing fish species composition and characterizing fish habitat, information from many sources must be integrated and summarized. Literature review may include, but is not limited to, the following existing sources:

- DWR Lake Oroville Annual Reports of Fish Stocking and Fish Habitat Enhancements to FERC, 1994-1999 - Lake Oroville fishery management information, resident fish stocking data, resident fish species data, and fish habitat enhancement projects.
- DWR Lake Oroville 90-Day Fishery Reports to FERC, 1995-1999 - Lake Oroville fishery management information, resident fish species data, resident fish stocking data, fish habitat enhancement projects, and water temperature profiles.
- DWR Lake Oroville Fisheries Habitat Enhancement Plan, 1995 - Lake Oroville fish habitat and habitat enhancement information.
- DWR Lake Oroville Fishery Management Plan Progress Report, October 1993 - Lake Oroville fishery and tributary information.
- DWR Amended Recreation Plan for Lake Oroville State Recreation Area, 1993 - Lake Oroville fishery information.
- DWR project operations data, including surface elevations of project reservoirs and inflow/outflow data.
- PG&E FERC relicensing proceedings and studies of North Fork Feather River projects - Including draft

Poe Project License Application, existing Poe license with conditions; Rock Creek Cresta License and conditions. Information on tributary (North Fork Feather River) fish.

- DFG: An Evaluation of Fish Populations and Fisheries in the Post-Oroville Project Feather River, 1977.
- DFG: Inland Fisheries Division - Information Leaflet No. 42, Warm Water Reservoir Fish Habitat Improvement Guide.
- DFG Annual Reports on Fish Habitat Enhancement.
- DFG Strategic Plan for Trout Management.
- 1993-1994 DWR Lake Oroville Siltation Study.
- Historic literature related to fish habitat within the FERC project waters.
- Concurrent studies occurring as part of the Oroville Facilities FERC relicensing process.
- Monitoring studies and management practices for sturgeon from reservoirs which actively managed for sturgeon (i.e., Lake Shasta)

If initial study results indicate that the methods and tasks should be modified, the Environmental Work Group will discuss the basis for change and revise the study plans as appropriate.

Detailed Methodology and Analysis

Task 1—Characterize Upstream ~~migration~~ Migration Barriers, Fish Species Composition, and Fish Habitat in Lake Oroville's Upstream Tributaries

There are four main tributaries to Lake Oroville: the North Fork Feather River, West Branch of the North Fork Feather River, Middle Fork Feather River, and South Fork Feather River. Additionally, there are a number of smaller tributaries (tributaries that are 2nd order or larger) evaluated in Task 1A including Berry Creek, Canyon Creek, Chino Creek, Concow Creek, Fall River, French Creek, Frey Creek, Sucker Run Creek, McCabe Creek and Stony Creek. In general, the upstream tributaries can be classified into two types: those above Lake Oroville's high water mark and those within the fluctuation zone of Lake Oroville below the high water mark. Below Lake Oroville's high water mark are tributaries that lie within the lakebed. Because these tributaries are within the fluctuation zone of Lake Oroville, the extent of the tributaries falling into this category is therefore dependent upon the ~~surface water~~water surface elevation of Lake Oroville. When Lake Oroville is at full pool, the main tributaries are inundated to the high water mark and are part of Lake Oroville. When Lake Oroville is not at full pool, tributaries run as streams or rivers until they reach the surface of Lake Oroville. When Lake Oroville is not at full pool, the tributaries within Lake Oroville's fluctuation zone are exposed, revealing a dynamic system with reduced shoreline vegetation. Additionally, this section of the upstream tributaries receives sediment and sand deposits during flood events, and sediment plugs exist as a result of the sediment deposition during the floods of January, 1997. Near the interface of Lake Oroville and its upstream tributaries and in the tributary reaches that are within the fluctuation zone, the fish assemblages are similar to those in Lake Oroville (see Task 2).

The tributaries above Lake Oroville's high water mark are different from those within the fluctuation zone of Lake Oroville because they are not seasonally inundated as are the tributaries within the fluctuation zone of Lake Oroville. Habitat in these reaches of the upstream tributaries is similar to mountain trout stream habitat and includes habitat that has the potential to support salmonid spawning and rearing. Generally the upstream tributaries are managed for coldwater fish species, although flow and water temperature components of the habitat are not controlled by the Oroville Project. Upstream of the high water mark of Lake Oroville, the tributaries support a typical California foothill stream-dwelling fish assemblage, which includes rainbow trout, brown trout, several black bass species such as smallmouth bass, spotted bass, largemouth bass, and redeye bass, hardhead, ~~bass,~~ pikeminnow, and Sacramento sucker. When Lake Oroville is at high water surface ~~water~~ elevation (typically in the spring), fish are able to pass over the sediment plugs that exist within the fluctuation zone of Lake Oroville and are able to access the reaches of the tributaries upstream of Lake Oroville's high water mark. When Lake Oroville is at low water surface ~~water~~ elevation (typically in the fall), low water levels in the tributaries within the fluctuation zone may be low enough to prevent access to the tributaries above Lake Oroville’s high water mark. In this case, fish are not able to access the spawning areas in the regions of the tributaries above Lake Oroville’s high water mark.

The objective of the subtasks under Task 1 is to provide baseline information regarding fish species composition and fish habitat in the upstream tributaries to support specific analyses in SP-F5, SP-F8 and SP-F15. Additionally, the baseline information collected regarding the upstream tributaries will serve as a foundation for future evaluations and development ~~and evaluation of~~ potential ~~future~~ PM&Es. Task 1A will identify upstream migration barriers, Task 2 1B will describe fish species composition in the upstream tributaries, and Task 1C will characterize the fish habitat in upstream tributaries.

Task 1A-Identify Upstream Migration Barriers

Introduction. Because there are two distinct reaches of upstream tributaries, the areas within the fluctuation zone of Lake Oroville and the areas above Lake Oroville's high water mark, two types of upstream migration barriers will be identified in Task 1A. The two types of migration barriers are fundamentally different for several reasons and therefore warrant different types of field surveys and evaluations. In the reaches of the tributaries that are above Lake Oroville's high water mark, the migration barriers are generally geologic features, such as a waterfall, or a man-made structures, such as a dam. In the reaches of the tributaries that are within the fluctuation zone of Lake Oroville and are fully inundated during portions of the year, the sediment plugs resulting from sediment deposition during high flows are the potential upstream migration barriers. The sediment plugs are part of a dynamic system which changes more quickly than a geologic feature. Sediment plugs may be stable for a period of several months to a few years depending upon flow, reservoir level fluctuation and duration, rate of sediment deposition, and other factors which will be assessed in SP-G1. A sediment plug that prevents fish passage may be moved during a high flow event or eroded due to tributary flows, thereby eliminating that plug as a potential passage barrier. Additionally, sediment plugs in reaches of the tributaries within the fluctuation zone of Lake Oroville are directly influenced by project operations. For example, when Lake Oroville has high water surface elevation, sediment deposits in the uppers reaches of the lake. When lake levels are lowered, sediment is eroded, causing large amounts of sediments to move. Waterfalls and dams are stable over a much longer period of time and their stability is generally not under the immediate control of the project. The first part of Task 1A will identify the first upstream migration barrier in each of the tributaries second order or larger above the high water mark of Lake Oroville, while the second portion of Task 1A will identify the potential passage barriers within the fluctuation zone of Lake Oroville.

Identification of the first upstream migration barrier above Lake Oroville's high water mark.

Literature Review. The first upstream migration barrier on tributaries 2nd order or larger will be identified using two complementary methods: a literature review and field surveys designed to identify migration barriers. The literature review will assimilate the existing information regarding the extent of upstream migration of salmon into Lake Oroville's upstream tributaries. Available literature treating this topic will be reviewed, including assessments of upstream migration barriers conducted previously by DWR (DWR 1993), by other agencies such as DFG (DFG 1952), and by other researchers (for example, Yoshiyama et al., 1996). In addition to reports describing the extent of upstream salmonid migration i~~o~~n upstream tributaries, information regarding the history of functionality of the Big Bend Dam fish ladder will be reviewed and summarized. This information will be used to aid in adequately assessing whether Big Bend Dam fish ladder allowed salmonid passage over Big Bend Dam. This information will be utilized by SP-F8 in determining the historical escapement of salmon in Lake Oroville's upstream tributaries.

In addition to summarizing available informat ion regarding identification of upstream migration barriers, the literature review will also compile and summarize passage criteria for salmon. Because salmon stocked in reservoirs (inland salmon) are generally smaller than salmon that migrate from the ocean, and because passage ability is related to size, inland salmon will generally not be able to pass all barriers that ocean-grown (anadromous) salmon are capable of passing. As a result, potential passage barriers will be evaluated for passage by two guilds of salmon: anadromous salmon and inland salmon. Additionally, potential passage barriers will also be evaluated for the likelihood of sturgeon passage because suggested PM&Es may include management of Lake Oroville for sturgeon. Data from Lake Almanor, Lake Shasta, and other reservoirs that have specifically investigated the passage capabilities of inland salmon and sturgeon (also see Task 2C) will be reviewed and summarized. Additional appropriate laboratory studies and literature describing passage abilities of inland and anadromous salmon and sturgeon may also be included. Size-based passage characteristics from salmon in other reservoirs or studies will be compared to Lake Oroville salmon sizes to provide an indication of inland salmon passage ability. Likewise, the sized-based passage characteristics describing passage ability by anadromous salmonids will be compared to the sizes of anadromous Feather River salmon to provide additional indication of anadromous salmon passage ability. The literature review is designed to provide a range of conditions over which inland-sized salmon, anadromous-sized salmon, and sturgeon are able to pass over potential barriers and to provide support for field surveys described below. It is not designed to be a detailed quantitative passage analysis.

Field surveys. Field identification of upstream passage barriers above Lake Oroville's high water mark will be completed in coordination with the literature review. Field surveys will identify the first upstream migration barrier on each tributary of 2nd order or larger (named above) for inland salmon, anadromous salmon, and sturgeon. Field surveys will occur in the spring (2003) and fall (2002) because these two seasons generally represent the highest and lowest tributary flow levels, representing the range of conditions upmigrating fish are likely to encounter. In the spring, tributary flow is usually highest, and access to the upper reaches of the tributaries to previously identified migration barriers by boat is generally possible. In the fall, tributary flow is typically lower, and as a result, structures which may have been passable during higher flows in spring may constitute passage barriers under lower flow conditions. During field surveys, videos and pictures of the passage barriers will be taken. It is expected that visual assessment of potential barriers will generally allow discernment of whether or not passage is possible by inland-sized salmon, anadromous-sized salmon and sturgeon. In cases where visual assessment cannot easily determine whether or not a barrier is passable, passage information compiled in the literature review summarizing the range of conditions over which passage for inland-sized salmon, anadromous-sized salmon and sturgeon is possible will be used to estimate the likelihood of passage by salmon and sturgeon. The findings of this portion of Task 1A, including the literature review and identification of the first upstream migration barrier as detailed above, will be described in a draft report which will be completed by August of 2003.

Identification of the upstream migration barrier within the fluctuation zone of Lake Oroville.

As mentioned earlier, within the fluctuation zone of Lake Oroville, the most likely upstream passage impediments are dynamic sediment plugs resulting from sediment deposition at periods of high flow. Geomorphic characterization of sediment plugs and field surveys will be conducted to estimate the ability of inland-sized salmon, anadromous-sized salmon and sturgeon passage above sediment plugs with in the fluctuation zone of Lake Oroville. Most of the required information for this assessment will be provided by SP-G1, whose objectives include evaluating sediment sources (including tributaries) and conditions, mapping major sediment deposits and evaluating upstream channel stability. ~~In Task 2,~~ SP-G1 will provide maps of the channel resources in the tributaries above Oroville Dam constructed using a combination of cross-sectional surveys, sonar and GPS. SP-G1 will provide SP-F3.1 with the reservoir level (water surface elevation) at which each major sediment plug becomes exposed. Additionally, SP-G1 will provide either cross-sectional data or a sonar-generated image that will describe the shape and character of the sediment plug. The geomorphologic characterization of plug shape combined with the reservoir level required to inundate the plug will allow an assessment of whether or not the plug is passable by inland-sized salmon, anadromous-sized salmon and sturgeon. The geomorphic characterization is required because two sediment plugs may be inundated at similar water surface elevations, but one may be eroded such that the tributaries flows sufficiently to allow passage, while the other may not yet be eroded, thereby currently blocking fish passage.

As with the identification of upstream migration barriers above the fluctuation zone of Lake Oroville, in cases where the passability of a barrier is not easily determined, sized-based passage criteria from the literature review (see above) may be applied to metrics taken during the cross-sectional monitoring of tributaries (Task 4 of SP-G1). Cross-sectional monitoring of upstream tributaries will occur at representative low, medium and high flows in order to cover the full spectrum of streamflow and sediment transport. Additionally, ~~SP-G1 suggests that~~ cross-sectional monitoring in SP-G1 ~~should~~ will occur at low reservoir levels when the tributaries are ~~most actively~~ flowing the longest distance through the fluctuation zone. Analysis of sediment plugs with respect to passage will be conducted during low reservoir levels and low tributary flows as these conditions are most likely to reveal potential passage impediments. In the fall of 2002, during low reservoir levels and low tributary flow conditions, a field survey will be conducted to allow visual observation and identification of plugs which are potential passage impediments. The field survey will be conducted as described above, using videos and pictures to document conditions at the sediment plug during low flows. Information from the geomorphologic characterization and field surveys will be used to estimate the passability of major sediment plugs.

Because sediment plugs are dynamic, an evaluation of their potential to block fish passage is not complete without treatment of their stability and longevity. Consideration of stability is also important for developing tools for future evaluations and ~~the~~ development of ~~future~~ potential PM&Es. For example, a sediment plug that is highly unstable and likely to erode quickly would be a less likely target for a PM&E than one that is

~~highly~~ more stable and likely to ~~block passage~~endure for a longer duration under most operating conditions. Sediment plug stability will be evaluated by in Task 5 of SP-G1. Specific considerations to be addressed in this evaluation include the temporal stability of the sediment plugs, the relationship of sediment plug stability to tributary flows, the relationship of sediment plug stability/longevity to the frequency of inundation/location within the fluctuation zone, the likelihood of sediment plug transport, the relationship between sediment plug formation and total sediment load in the tributary, and the relationship between sediment plug formation and changes in the water surface elevation of Lake Oroville. Because assessment of potential fish passage impediments within the fluctuation zone of Lake Oroville is dependent upon data from SP-G1, the results of this portion of Task 1A will be presented in a final report which will be completed 3 months following the completion of SP-G1 data collection and sediment stability analysis. This final report will also incorporate the results of the assessment of ~~upmigration~~ upstream migration barriers above Lake Oroville's high water mark, thereby serving as the final report for the first portion of Task 1A.

Task 1B-Describe Fish Species Composition in Lake Oroville's Upstream Tributaries

Little field sampling has been conducted in Lake Oroville's upstream tributaries, with the exception of the North Fork Feather River. Fish distribution in the North Fork Feather River has been investigated by PG&E through snorkel surveys and electroshocking because of the operation of Poe Dam and Big Bend Dam. As a result, the only main upstream tributary for which existing data is expected to be adequate is the North Fork Feather River. The existing data on the North Fork Feather River will be summarized in a literature review (see literature review), while description of fish species composition in other upstream tributaries will require additional field studies (see field surveys).

Literature Review. Fish distribution data collected on the North Fork Feather River by government agencies or by other hydropower project operators (such as PG&E) will be collected and summarized for use in describing fish species composition in Lake Oroville's upstream tributaries. Information including reports or studies by federal and state agencies, reports generated by hydropower project operators, scientific papers, creel census reports, or other available relevant information will be reviewed and summarized in order to describe fish distribution on the North Fork Feather River. Although fish sampling on upstream tributaries other than the North Fork Feather River has been minimal and existing data are anticipated to provide little information regarding fish distribution, available information from any other upper tributary fish sampling by DWR or other agencies will be summarized through this literature review and incorporated into the final report describing fish distribution.

Field ~~surveys~~Surveys. Because of the lack of information regarding fish distribution in upstream tributaries other than the North Fork Feather River, field sampling will be conducted to determine fish presence and to estimate the number of adult salmonids ~~spawning~~ in upstream tributaries. Three tributaries have been chosen for sampling: the Middle Fork Feather River, the West Branch of the North Fork Feather River, and Sucker Run Creek. These three tributaries have been chosen because they have some migration capacity, because they represent a range of tributary sizes, and because they represent at least one tributary on each of the major reservoir arms for which data is needed. In the three upstream tributaries above the fluctuation zone of Lake Oroville, snorkel surveys will be conducted in the spring (2003) and fall (2002) to determine distribution of fish. Snorkel survey methodology will be similar to the broad scale survey methods detailed in Task 3A of

SP-F10. The exact timing of the survey will depend on external factors such as access, safety, lifestage timing of fish of primary management concern, water clarity, and weather conditions. Representative habitat units will be chosen for snorkel surveys based on a randomly stratified sampling design that will utilize the habitat types (mapped in Task 1C) as strata. Snorkel surveys will be conducted to determine fish distribution in shallow pools and streams, and electroshocking will be conducted using a backpack shocker to determine distribution in deep pools. Presence and estimated numbers of juvenile and adult fish observed during these surveys will be recorded.

If there are fish species of primary management concern observed during the snorkel surveys in Lake Oroville's upstream tributaries whose life history characteristics and habitat requirements have not been summarized in either SP-F10 or SP-F3.2, this information will be reviewed and compiled as part of Task 1B. Contingent on the information available, the following topics will be included in the review:

- Habitat requirements of non-salmonids by species and lifestage (habitat types, water temperatures, water depth, water velocity, substrate, etc.);
- Adult migration characteristics (timing, and water temperature and flow conditions);
- Spawning characteristics (habitat availability, timing, and factors affecting timing and success such as substrate conditions and water temperatures);
- Early development (factors affecting incubation and survival during incubation);
- Juvenile rearing (water temperature, flow, substrate characteristics, refuges, shade, cover, food availability); and
- Juvenile movements (timing, prevalent flow, water temperature and other abiotic conditions, predation, stranding).

This task will provide species-specific life history descriptions and habitat requirements for fish in Lake Oroville's upstream tributaries, characterize the fish community (predators, prey, competitors), and classify fish species and/or their life stages in guilds according to their habitat requirements (warmwater or coldwater, bottom or pelagic, lentic or lotic dwellers).

A final report detailing the findings of Task 1B including the literature review and snorkel survey results describing the distribution of fish in Lake Oroville's upstream tributaries will be completed by August of 2003. If necessary, this report will also include a summary of life history characteristics and habitat requirements of fish observed in the upstream tributaries.

<u>Task 1C-Characterize Fish Habitat in Lake Oroville's Upstream Tributaries from Lake Oroville's High Water Mark to the Identified Migration Barrier</u>

Task 1C identifies available habitat in Lake Oroville's upstream tributaries from Lake Oroville's high water mark to the first upstream migration barrier (identified in Task 1A). The framework and methodology for this task are based on the framework and methodology used in Task 4 and 5A of SP-F3.2. Habitat maps for each of Lake Oroville's upstream tributaries of 2nd order or higher will be constructed ~~from~~ using data collected in ~~other~~ <u>concurrent</u> FERC relicensing <u>study plans as described below</u>. The description of available habitat will be based on a review and summarization of existing data and reports on physical and hydrological characteristics of the study area as the characteristics pertain to species-specific habitat requirements. Studies being completed as part of the FERC relicensing process will be reviewed and will provide data necessary to identify available habitat. The review will use available cartographic information (e.g., aerial photographs) and habitat characterization information obtained from SP-G1, SP-T4, SP-W6 and SP-W1.

GIS coverages of habitat components will be developed to estimate the location, extent and relative qualities of habitat. Habitat locations will be determined by combining the habitat component coverages to identify areas with combinations of habitat characteristics that fit the profile of each fish's habitat preferences. Habitat components to be combined to identify fish habitat include:

- mesohabitat maps provided by SP-G1;
- substrate characterization, transect data, channel morphology, assessment of woody debris, and cover cross-sectional monitoring data including water depth, velocity, and turbidity obtained from SP-G1;
- inundation flow boundaries at various flow levels interpolated from SP-G1 channel transects;
- vegetation survey results (grass, shrub, bush, tree classes) obtained from SP-T4;
- water temperature data obtained from SP-W6;
- water quality data obtained from SP-W1; and
- exceedances of water quality recommendations for freshwater aquatic life obtained from SP-W1.~~;~~

In this task, habitat data from the study plans named above will be integrated to produce GIS coverages of existing habitat conditions for the tributaries of 2nd order or higher upstream of Lake Oroville's high water mark named in section 4.0 Study Area (for additional discussion of specific fisheries needs from other FERC study plans, see section 7.0 Coordination and Implementation). Habitat maps will be utilized by the analysis detailed below and by SP-F8 for estimation of amount of spawning habitat in the upstream tributaries. Additionally, data characterizing fish habitat in upstream tributaries will be utilized by SP-F15 for analysis of the feasibility to provide passage for anadromous salmonids past Oroville Facilities dams and by SP-F5/7 in describing interactions of interactions between managed reservoir fisheries and riverine fisheries, including Lake Oroville's upstream tributaries.

In addition to producing habitat maps, this task will utilize the summarized information (from SP-F10, SP-F3.2 or Task 1B of SP-F3.1) regarding habitat requirements for fish species by lifestage in the surveyed upstream tributaries (North Fork Feather River, Middle Fork Feather River, the West Branch of the North Fork Feather River, and Sucker Run Creek). Habitat requirements and lifestage characteristics will be separated by species, or by guild if several related species have similar requirements. By knowing the distribution of fish and their habitat requirements, relevant data describing habitat conditions (i.e., water temperature, amount of cover, dominant substrate size) provided by SP-G1, SP-W1 and SP-W6 will be integrated into the habitat maps (see above). These data can then be compared to habitat requirements to determine the extent to which existing conditions meet habitat requirements by lifestage. GIS coverages will be constructed that map the areas which provide suitable habitat for each species or guild by superimposing the habitat requirements of each species or guild over the existing conditions. Fish distribution data on the

North Fork Feather River, Middle Fork Feather River, the West Branch of the North Fork Feather River, and Sucker Run Creek obtained from Task 1B and the habitat requirements (obtained from SP-F10, SP-F3.2 or Task 1B of SP-F3.1) will be compared to the existing habitat (GIS coverage describing habitat distribution by species) in the upstream tributaries. GIS coverages describing habitat distribution by species or guild may also be used by SP-F5 in assessing the interactions between managed reservoir fisheries and riverine fisheries. The GIS coverages of each habitat component listed above and the GIS coverages describing habitat distribution by species or guild for each relevant lifestage will be presented in a final report, which will be completed three months following the completion of the first year of data collection in the supporting FERC plans named above. Initial GIS coverages will be completed by December 2002 and presented in an interim report. The final report will include relative fish distribution data gathered during the spring 2003 snorkel surveys and will be completed 3 months following the completion of the first year of data collection in the other supporting FERC plans.

Task 2—Describe Fish Species Composition in Lake Oroville, Evaluate Potential Project Effects on Cold Water Pool Availability and Water Surface Elevation Fluctuations, and Provide a Foundation for Future Evaluations and Development ~~and Evaluation~~ of Potential ~~Future~~ PM&Es Related to Lake Oroville Fisheries.

In general, Lake Oroville thermally stratifies in the spring, destratifies in the fall, and remains destratified throughout the winter. Lake Oroville supports a two-story fishery, which means that it supports both coldwater and warmwater fish species that are thermally segregated for most of the year. The coldwater fish use the deeper, cooler, well-oxygenated hypolimnion, whereas the warmwater fish are found in the warmer, shallower, epilimnetic and littoral zones. When Lake Oroville destratifies, the two fishery components mix in their habitat utilization. The Lake Oroville coldwater fishery is managed as a put and grow fishery, meaning that hatchery raised fish are stocked in Lake Oroville as juveniles, with the intent that they will grow in the lake before being caught by anglers (DWR 2001). ~~For the past 10 years~~From 1990-2000, the Lake Oroville coldwater fishery was managed for chinook salmon (*Oncorhynchus tshawytscha*) and brown trout (*Salmo trutta*) (DWR 2000). Recent disease concerns, including the prevalence of infectious hematopoietic necrosis virus (IHN), have prompted changes in the stocking procedures at Lake Oroville. Due to their susceptibility to IHN, chinook salmon and brown trout are not currently being stocked; however, stocking may resume in the future if IHN is eradicated. Beginning in 2002, coho salmon (*O. kisutch*) will be stocked as a replacement for chinook salmon and brown trout in order to maintain an attractive coldwater fishery in Lake Oroville, as they are less susceptible to IHN. The California Department of Fish and Game (DFG) manages the fishery with the primary objectives of producing trophy salmonids and providing a quality fishery characterized by high salmonid catch rates (DWR 2000). The coldwater fishery is sustained by hatchery stocking because natural recruitment to the Lake Oroville coldwater fishery is very low. The current salmonid fishery is not self-sustaining, possibly due to insufficient spawning and rearing habitat in the reservoir and accessible tributaries, and natural and artificial barriers to migration into the upstream tributaries with sufficient spawning and rearing habitat (DWR 2001).

The Lake Oroville warmwater fishery is a self-sustained fishery consisting of fish of the *Centrarchidae* (sunfish) family, including four species of black bass (*Micropterus punctulatus*, *M. salmoides*, *M. dolomieui* and *M. coosae*), two species of sunfish (*Lepomis cyanellus* and *L. macrochirus*), two species of crappie (*Pomoxis nigromaculatus* and *P. annularis*), and two species of catfish (channel catfish (*Ictalurus* *punctatus*) and white catfish (*I. catus*). In addition to game species, Lake Oroville provides habitat for many other fish species, including native fish such as Sacramento pikeminnow (*Ptychocheilus grandis),* hardhead (*Mylopharodon conocephalus),* Sacramento sucker (*Catostomus occidentalis*), and introduced fish such as carp (*Cyprinus carpio),* wakasagi (*Hypomesis nipponensis),* and threadfin shad (*Dorosoma petenense*).

Project operations influence fish habitat in Lake Oroville by manipulating the amount of cold water for downstream released into the Feather River and through changes in Lake Oroville's water surface elevation necessary for flood control, power generation, and water releases downstream. Project operations influence habitat for coldwater fish by manipulating the amount of cold water in Lake Oroville. Cold water is taken from Lake Oroville's hypolimnion for the purpose of supplying cold water to the downstream fishery in the main channel of the Feather River, thereby potentially limiting the amount of cold water available for salmonids in Lake Oroville.

Project operations that influence warmwater fish habitat include water surface elevation fluctuations resulting from flood control, power generation, and downstream fisheries management activities. Lake water surface elevation fluctuations may hinder colonization of rooted aquatic vegetation in the lake's littoral zone, limiting the establishment of terrestrial vegetation within the fluctuation zone (DWR 2001). Terrestrial vegetation provides spawning and nursery habitat, offers protection from predation, and results in increased food availability for warmwater fisheries (DWR 2001; DWR and USBR 2000). The availability of such vegetation may affect the abundance and distribution of warmwater fish (DWR 2001). Fluctuations in water surface elevation may also result in bass nest dewatering during spawning and incubation periods. Positive effects may also be associated with reservoir fluctuations. For example, low reservoir levels cause concentration of adult fish and the forage base because of the decrease in the total volume of water, resulting in adult fish with better condition factor. Aquatic weed growth is controlled with ~~surface water~~water surface fluctuations, and without these fluctuations, excessive aquatic plant growth may limit the amount of forgeable fish habitat. A certain amount of aquatic vegetation is beneficial to Lake Oroville fisheries because it provides escape cover for juvenile fish and increases food supply, but too much aquatic vegetation (greater than approximately 30%) may lead to negative impacts to planktonic communities, repressed feeding efficiency of adult fish, and seasonal decomposition-related oxygen depletion. Water surface elevation fluctuations in Lake Oroville are currently sufficient to prevent excessive aquatic vegetation growth.

The objectives of Task 2 are to describe the fish species composition in Lake Oroville, evaluate potential project effects on cold water pool availability and water surface elevation fluctuations with respect to Lake Oroville fisheries, and provide a foundation for future evaluations and development and evaluation of potential ~~future~~ PM&Es related to Lake Oroville fisheries. Task 2A describes fish species composition in Lake Oroville, while Tasks 2B and 2C evaluate the cold water pool availability and the impacts of water level fluctuation on bass nesting, respectively. Additionally, the information collected in Task 2D will serve to collect baseline information for future evaluations and ~~as a foundation for~~ development ~~and evaluation of~~ potential ~~future~~ PM&Es by summarizing management practices and monitoring studies focused on sturgeon in other reservoirs.

Task 2A- Describe Fish Species Composition in Lake Oroville

This task consists of a general review of existing information sources previously listed, as well as additional reports by federal and state agencies, scientific papers, salmonid stocking and creel census reports, and other sources such as regional newspapers to document species composition of fish in Lake Oroville. Existing data regarding fish species composition will be collected, reviewed, and summarized to document fish species in Lake Oroville, including electrofishing data collected during the spring and fall from 1993 to present, creel census data, gill netting data, and trap data. In addition to data summarized in reports and scientific papers, data that has not yet been summarized may provide useful information. If existing, relevant data has not been analyzed and incorporated into existing reports, it may be examined under Task 2A as a supplemental effort to improve our knowledge of fish species composition in Lake Oroville. For example, data collected as part of creel surveys, but not reported in the original report, may be re-examined for distribution data for fish that were observed during the effort, but that were not the target of analysis, and therefore not included in the report. Such raw data will be examined, analyzed, and incorporated as appropriate for describing fish species composition. Fish species composition data review will include all fish species reported in existing field data collection efforts and reports, not only fish species of primary management concern.

In addition to determining fish species composition in Lake Oroville, any available information describing relative abundance and distribution of fish species of primary management concern will be incorporated, as possible. This information will serve as baseline information for future evaluations and as a foundation for development ~~and evaluation~~ of potential ~~future~~ PM&Es. As described above, if existing, relevant data has not been analyzed and incorporated into existing reports, it may be examined under Task 2A as a supplemental effort to improve our knowledge of fish distribution in Lake Oroville. For example, although data describing the relative distribution of fish species is obtained during creel surveys, it may not necessarily be presented by location in summary reports. Such raw data will be examined, analyzed, and incorporated as appropriate for describing the relative distribution of fish of primary management concern. Contingent on the information available, this review will include the following topics:

- Temporal and geographic distribution of fish;
- Characterization of the relative abundance of fish including, as available, seasonal and geographic variations in relative abundance; and
- Characterization of inter-annual variability in relative distribution and abundance.

If there are fish species of primary management concern reported in this review whose life history characteristics and habitat requirements have not been summarized in either SP-F10, SP-F3.2 or Task 1B of SP-F3.1, this information will be reviewed and compiled as part of Task 2A, as described in Task 1B above. A final report will be completed by June of 2003 and this report will incorporate data from the creel survey conducted in SP-R13, which terminates in April of 2003.

Task 2B-Evaluate Coldwater Pool Availability in Lake Oroville

The objective of the analysis of Lake Oroville's cold water pool is to estimate whether there is sufficient cold water in Lake Oroville to support current salmonid stocking goals. Salmonids, such as coho salmon which will be stocked in Lake Oroville beginning in 2002, require cold water. Because the amount of cold water present in Lake Oroville is determined in part by project operations and in part by external factors such as air temperature and precipitation, analysis of the extent of the cold water pool will incorporate varied hydrologic and climatic conditions by utilizing results of modeled exceedance estimates obtained from SP-E7. To estimate whether or not there is sufficient cold water in Lake Oroville to support current stocking recommendations for the coldwater fishery, exceedance graphs estimating the probability that there will be a certain volume of water below a certain temperature using the area-capacity curve for Lake Oroville will be obtained from SP-E7. The cold water pool volume exceedance curves will be generated on a monthly basis for each month and will be generated using a variety of hydrologic and climatic conditions. This data will allow determination of the likelihood (expressed as a percentage) that a certain volume of water will be below a certain temperature in each month.

The volume of cold water available will be divided by the number of coldwater fish required to meet stocking goals (obtained from stocking reports and SP-F5) to determine the volume of cold water available per fish. The amount of cold water available per fish will be calculated for months and conditions (hydrologic and climatic) simulated ~~by~~ in SP-E7. A literature review of laboratory/field studies, stocking reports, and other agency reports will be conducted in order to generate an estimate of the minimum fish density of fish to ~~prevent overcrowding~~. The loading density recommended by the literature review will then be compared to the calculated density of fish in Lake Oroville's cold water pool to determine whether there is enough cold water to support the stocking recommendations. A final report will be completed three months following the completion of SP-E7.

Task 2C-Evaluate the Impacts of Water Surface Elevation Reductions on Bass Nests in Lake Oroville

The objective of Task 2C is to assess the impact of water level reductions on survival of bass nests using criteria developed by DFG (Lee et al. 1999) describing the relationship between water level reductions and bass nest dewatering. In order to determine whether bass nests are inundated long enough, water surface elevation reductions during bass spawning and incubation will be investigated. The average daily reduction rate in reservoir water surface elevation (meters per day) occurring during each month of the primary spawning and early rearing period for nest-building fish (April through September) will be determined by examining operations records for Lake Oroville. Because water surface elevation fluctuations differ from year-to-year and vary among water year types, average daily water surface elevation reduction will be calculated for each month (April through September) for three water-year types (dry, normal, and wet) using data from several dry years, normal years, and wet years. A recent study by DFG, which examined the relationship between reservoir elevation fluctuation rates and nesting success for black bass, suggests that a reduction rate of 0.15, 0.18, and 0.39 meter per day (m/day) or greater would result in 100 percent nest mortality (or zero percent nest survival) for largemouth bass, smallmouth bass, and spotted bass, respectively (Lee et al. 1999). However, nest survival criteria developed by DFG suggests that on average, a nest survival rate of at least 20 percent is necessary to maintain the long-term population levels of high-fecundity, warmwater fish (D. Lee, pers. comm. 1999). Using nest survival curves developed by DFG (Lee et al. 1999), reservoir water surface elevation reduction criteria for Lake Oroville that would provide a minimum nest survival rate of approximately 20 percent for largemouth bass, the bass species found by DFG to be most sensitive to reservoir elevation fluctuations, will be calculated by applying DFG nest survival curves to reservoir storage - elevation relationships. The reservoir reduction criteria that would provide a survival rate of greater than 20 percent can then be compared to the actual average daily reservoir reduc~~u~~tion levels determined from reservoir operations. Average daily water surface elevation reductions occurring in each month of dry, normal and wet years will be compared to the calculated fluctuation rates corresponding to greater than 20% nest survival to evaluation potential effects of project operations on bass nest dewatering. A final report detailing the findings of Task 2C will be completed by November 2002.

Task 2D-Review Management Practices and Monitoring Studies of Sturgeon from Other Reservoirs ~~Actively Managed for Sturgeon~~

Although not a fish of primary management concern, green sturgeon have been identified as the target of this specific desktop investigation. The purpose of this investigation is to summarize information regarding management practices from reservoirs that are actively managed for sturgeon. In addition to evaluating potential project effects, this study plan is designed to provide baseline information useful for future evaluations and ~~the~~ development ~~and evaluation~~ of potential ~~future~~ PM&Es. One potential PM&E may include active management of Lake Oroville for sturgeon. Therefore, a literature review summarizing management activities and the results of monitoring studies designed to evaluate the effectiveness of such management activities will provide a mechanism for developing a potential sturgeon management plan and evaluating the likelihood of success of such a program in Lake Oroville. For example, Lake Shasta is actively managed for ~~sturgeon and has performed tagging and monitoring studies that may provide useful information regarding the potential for a managed sturgeon fishery in Lake Oroville.~~ Lake Shasta management policies, monitoring and tagging studies, and progress reports will be reviewed and summarized for their potential applicability to Lake Oroville ~~and summarized~~. Similar information from other California reservoirs that are managed for sturgeon may also be summarized and reviewed for their applicability to Lake Oroville. A report detailing the findings of Task 2D will be completed by November of 2002.

Task 3—Describe the Fish Species Composition, Fish Habitat Characteristics, and Project Operations Influencing the Thermalito Diversion Pool and Thermalito Forebay

The Thermalito Diversion Pool is a two to three mile long, steep-sided, narrow, riverine reservoir with low surface-to-volume ratio and little ~~surface water~~water surface elevation fluctuations (DWR 2001). The Thermalito Diversion Pool is supplied with cold water from Lake Oroville's hypolimnion in order to meet water temperature requirements at the Feather River Hatchery and at Robinson Riffle in the main channel of the Feather River. As a result of the primarily cold water habitat, the Thermalito Diversion Pool fishery is dominated by coldwater salmonids including rainbow trout (*O. mykiss*), brook trout (*Salvelinus fontinalis*), brown trout, and chinook salmon (DWR 2001). Although the Diversion Pool is not currently stocked, the lack of barriers between the Diversion Pool and the Thermalito Forebay allow fish stocked in the Forebay to migrate freely into the Diversion Pool (DWR 2001). Entrained wakasagi resulting from release of power plant effluent into the Thermalito Diversion Pool contributes to the existing food web in the Diversion Pool, resulting in an abundant forage base for salmonids (DWR 2001).

The Thermalito Forebay is an open, cold, shallow reservoir with a high surface-to-volume ratio with little ~~surface water~~water surface elevation fluctuations (DWR 2001). Because of the cool water temperatures, the Forebay provides habitat primarily for coldwater fish (DWR 2001). DFG manages the Thermalito Forebay as a put-and-take trout fishery, where rainbow trout and brook trout of approximately 1/2 pound are stocked biweekly (DWR 2001). Surplus inland chinook salmon from Lake Oroville stocking efforts also have been stocked in the Thermalito Forebay in February of 2000 (DWR 2001). The Thermalito Forebay is the second most popular reservoir sport fishery of the Oroville Facilities (DWR 2001). The Thermalito Forebay and Thermalito Diversion Pool will be considered together because they are connected by the Thermalito Power Canal and fish can move freely from one water body to another, they provide primarily cold water habitat, and they are effected by project operations in ~~a~~ similar ways.

The objectives of Task 3 are to describe the fish species composition, habitat characteristics, and project operations influencing the Thermalito Diversion Pool and Thermalito Forebay. Task 3A describes fish species composition in the Thermalito Diversion Pool and Thermalito Forebay using existing data and concurrently gathered data, while Task 3B utilizes data from other FERC study plans to describe the general habitat characteristics of these two reservoirs. Task 3C describes the project operations which influence the fish habitat in Thermalito Diversion Pool and Thermalito Forebay. Additionally, ~~T~~the information collected in all subtasks of Task 3 will provide~~ing~~ baseline information necessary for future evaluations and ~~the~~ development and evaluation of potential future PM&Es.

Task 3A-Describe Fish Species Composition in the Thermalito Diversion Pool and Thermalito Forebay

The objective of Task 3A is to describe the fish species composition in the Thermalito Diversion Pool and the Thermalito Forebay. to provide a baseline for use in developing and evaluating potential future PM&E ~~measures and for use in SP-F5.~~ Existing data describing fish species composition is generally expected to be sufficient to document species composition in the Thermalito Diversion Pool and the Thermalito Forebay. In the Thermalito Diversion Pool existing data includes creel survey data, electrofishing data, and trapnetting data. In addition to this data, new creel data will be collected ~~by~~ in SP-R13 through April of 2003. Gill netting will be conducted by DFG in the Thermalito Diversion Pool to obtain tissue samples for mercury analysis in conjunction with SP-W2, and species composition data resulting from the gill netting effort will be incorporated into this analysis. These data will be incorporated along with existing data to describe fish species composition in the Thermalito Diversion Pool. Creel data, trapnetting data, electrofishing data, and stocking reports are expected to provide sufficient information for description of species composition in the Thermalito Forebay. Creel survey data from SP-R13 will also supply additional information describing fish species composition in the Thermalito Forebay. If there are fish species of primary management concern reported in the Thermalito Diversion Pool or Thermalito Forebay whose life history characteristics and habitat requirements have not been summarized in either SP-F10, SP-F3.2 or Task 1B or 2A of SP-F3.1, this information will be reviewed and compiled as part of Task 3, as described in Task 1B above. A final report detailing the findings of Task 3A will be completed by June of 2003 and this report will incorporate data from the creel survey conducted in SP-R13, which terminates in April of 2003, and species composition data obtained during DFG sampling in coordination with SP-W2.

Task 3B-Characterize Fish Habitat in the Thermalito Diversion Pool and Thermalito Forebay

The objective of Task 3B is to describe the general habitat characteristics in the Thermalito Diversion Pool and Thermalito Forebay.~~ to provide a baseline for use in developing and evaluating potential future PM&E~~

~~measures.~~ The physical reservoir characteristics of both the Thermalito Diversion Pool and Thermalito Forebay will be described using existing information and studies, including DWR facilities documents and studies. Physical reservoir characteristics include volume and morphometry, and may include substrate information if available. Water temperature data will be collected and summarized from SP-W6. In SP-W6, three water temperature profiling locations will be sampled in the Thermalito Diversion Pool and two locations will be sampled in the Thermalito Forebay. Vertical water temperature profiles will be taken at half-meter to one-meter intervals using a thermistor on a monthly basis during the winter and biweekly from spring ~~until~~ through fall. Water quality data for the Thermalito Diversion Pool and Thermalito Forebay will be provided by SP-W1. As in SP-W6, water quality sampling will occur in three locations in the Thermalito Diversion Pool and sampling will occur in two locations in the Thermalito Forebay. Sampling will include monthly sampling for field parameters, inorganic chemistry, pesticides, coliform bacteria, and plankton as described in SP-W1. Vegetation maps will be provided by SP-T4 and will include Wildlife Habitat Relationship classes that will be distilled into 4 general classes: grass, brush, shrub, and tree. The data from supporting plans will be summarized to provide baseline information about existing habitat conditions for use in future evaluations and development~~ing~~ ~~and evaluating~~ of potential PM&Es. A final report detailing the findings of Task 3B will be completed three months following the first year of data collection in supporting FERC study plans and will include a description of current habitat conditions.

Task 3C-Describe Project Operations Influencing the Thermalito Diversion Pool and Thermalito Forebay

The objective of Task 3C is to describe the project operations that influence the fish habitat in the Thermalito Diversion Pool and Thermalito Forebay and~~. This description is designed to~~ provide baseline information for use in future evaluations and development of~~ing and evaluating~~ potential ~~future~~ PM&E measures. Identified project operations to be characterized include pumpback operations, power generating operations, and water temperature controls to meet Feather River Hatchery and downstream temperature requirements. Pumpback operations, power generation operations, and operations required to meet hatchery and downstream water temperature objectives will be characterized and summarized from existing DWR reservoir and hatchery operations records. The description of how these operations influence habitat components (i.e., water temperature and water level fluctuations) in the Thermalito Diversion Pool and Thermalito Forebay is designed to be a qualitative, conceptual, descriptive narrative which will provide a baseline characterization of operations influencing these reservoirs and will be based on information in existing operational guidelines and DWR operations records.

Additionally, the effect of pumpback operations and power generation on water temperature may be described using data collected under SP-E8 and SP-W6, respectively. In SP-E8, water temperature data will be collected during pumpback operations in the Thermalito Forebay and the Thermalito Diversion Pool. Water temperature data will be collected in these two reservoirs throughout the year in SP-W6. These data will be compared to water temperature requirements for fish of primary management concern (see summary of life history requirements in SP-F10, Task 2 of SP-F3.2 and Tasks 1B and 2A of SP-F3.1) to determine whether power generation or pumpback operations results in water temperature regimes that support fish of primary management concern. A final report containing the findings of Task 3C will be completed three months following completion of required data collection in SP-E8 and SP-W6.

Task 4—Describe Fish Species Distribution, Evaluate Recruitment of Juvenile Bass, Characterize the Cold Water Pool Availability, and Evaluate Water Level Fluctuations in the Thermalito Afterbay

The Thermalito Afterbay is a large, shallow reservoir with a high surface-to-volume ratio and frequent water level fluctuations (DWR 2001). Because of the morphometry and operations of the Thermalito Afterbay, it has the most complex hydrologic regime of any project reservoir (DWR 2001). Be cause the Thermalito Afterbay is shallow (~~approximately~~ approximate maximum depth of 20 feet ~~deep~~), wind is a factor in the circulation patterns in the Thermalito Afterbay. Some areas do not circulate thoroughly, warming faster than other areas, causing a complex thermal regime (DWR 2001). Additionally, during pump-back operations, water is released from the Thermalito Afterbay Outlet and also pumped back into the power canal, thereby adding to the complexity of the circulation regime (DWR 2001). Thermal stratification of the water in the Thermalito Afterbay in the summer months also contributes to the complex thermal regime in this reservoir.

Water surface elevation can fluctuate rapidly and frequently in the Thermalito Afterbay and there is a high degree of variability in water levels from week to week depending on project operations. Unlike Lake Oroville, whose water surface elevation fluctuates on a seasonal scale, the water surface elevation in the Thermalito Afterbay may fluctuate on a weekly scale. When the Thermalito Afterbay fluctuates on a weekly scale, the reservoir is maintained at low levels in the beginning of the week and as power is generated through the Thermalito Pumping-Generating Plant, the reservoir is filled. By the end of the week, the reservoir water surface elevation is higher and over the weekend it is drawn down to provide storage for the next week. ~~Adequate~~ Existing typical water level fluctuations in the Thermalito Afterbay are sufficient to prevent the growth and density of aquatic weeds to levels that are detrimental to fish. The water level fluctuation in the Thermalito Afterbay likely impacts warmwater fish by dewatering bass nests and removing juveniles from their protective habitat, exposing them to greater risk of predation.

Because of the complex thermal regime, the Thermalito Afterbay provides warm water and cold water habitat. The Thermalito Afterbay boasts a popular largemouth bass fishery, and other warmwater species including smallmouth bass, spotted bass, sunfish, bluegill, crappie, catfish, and carp, have been observed in the Afterbay (DWR 2001). Although salmonids are not currently stocked, trout have been observed in the Thermalito Afterbay and large trout are sometimes caught near the Thermalito Afterbay inlet (DWR 2001). It is likely that the thermal heterogeneity that occurs in the Thermalito Afterbay provides habitat for coldwater and warmwater fish species.

The objective of Task 4 is to describe fish species distribution in the Thermalito Afterbay and characterize and evaluate the cold water pool availability and water level fluctuations in the Thermalito Afterbay. Task 4A documents fish species composition in the Thermalito Afterbay ~~in order to evaluate potential project effects and to provide a baseline for development and evaluation of potential futures PM&Es~~ and evaluates recruitment of juvenile bass into the Thermalito Afterbay. Task 4B characterizes the cold water pool availability in the Thermalito Afterbay using water temperature data from SP-W6, while Task 4C characterizes inundated littoral habitat and evaluates the effects of water level fluctuations on bass nest dewatering.

Task 4A-Describe Fish Species Composition and Evaluate Juvenile Bass Recruitment in the Thermalito Afterbay

Because there is no regular fish sampling program in the Thermalito Afterbay or OWA ponds, it is unlikely that sufficient information exists to describe fish species composition in either of these two areas. DFG will add the Thermalito Afterbay and an OWA pond (see Task 5B) to their scheduled electroshocking sampling locations. Shocking will take place over one day in the spring and one day in the fall, and the objective of the electroshocking is to determine fish species composition in the Thermalito Afterbay. Species information recorded during electroshocking sampling will include the number of fish of each species and fish metrics, including length and weight. Results of electroshocking will be recorded by location (or habitat type), as possible, by electrofishing in one area (or habitat type), tallying species composition data, and then electroshocking in a different area (or habitat type). Because of the morphometry and surface area of the Thermalito Afterbay, additional suitable sampling methods, such as boat seining, may also be employed to determine species composition and fish metrics in the Thermalito Afterbay. Although existing data is not expected to provide sufficient information to document species composition, any relevant existing information describing fish species composition in the Thermalito Afterbay will be included in this description. Data from the creel survey conducted in SP-R13 may also provide information regarding fish species composition. Additionally, any available data describing the relative abundance and distribution of fish species of primary management concern , including data from electroshocking samplesing or boat seines, will be incorporated when possible. As with other tasks, if there are fish species of primary management concern in the Thermalito Afterbay whose life history characteristics and habitat requirements have not been summarized previously, this information will be reviewed and compiled as part of Task 4A, as described in Task 1B above.

The information provided by the description of fish species composition in the Thermalito Afterbay will provide a foundation for ~~the development~~ future evaluations and development ~~and evaluation~~ of potential PM&E measures. Additionally, fish metric data from electroshocking and/or boat seining for determination of fish species composition will also be used to calculate the young adult ratio (YAR) for bass in the Thermalito Afterbay. The YAR is the ratio of young adult fish to juvenile fish and can be used as an indicator of juvenile recruitment to the reservoir. The YAR for the Thermalito Afterbay will be compared to the YAR for other water bodies to provide an indication of recruitment and reproduction and in the Thermalito Afterbay versus other water bodies. YAR calculations will focus on bass, as bass are the largest component of the Thermalito Afterbay sport fishery. The YAR calculation is designed to provide a comparative indicator of recruitment, with the understanding that the two electrofishing surveys will provide information at two discrete snapshots in time. This analysis is not designed to provide a dynamic model of recruitment and reproduction, but rather to provide a comparative measure of recruitment and reproduction at two points in time that can be used to evaluate recruitment in the Thermalito Afterbay relative to other water bodies supporting warmwater fisheries. A final report summarizing the findings of Task 4A will be completed three months following the completion of the fish sampling (electroshocking and/or additional methods) and fish metrics data collection and creel survey data collection from SP-R13.

Task 4B-Characterize Cold Water Pool Availability in the Thermalito Afterbay

The objective of Task 4B is to characterize the cold water poll availability in the Thermalito Afterbay. Additionally, data collected in this task will collect baseline information to serve as a foundation for future evaluations and development of ~~future~~ potential PM&Es. One specific suggested PM&E is development and implementation of a salmonid stocking program in the Thermalito Afterbay~~. This study plan is designed to establish tools to evaluate future potential PM&Es~~, and therefore an evaluation of the cold water pool availability in the Thermalito is necessary to provide the tools to determine whether this potential PM&E is potentially feasible or beneficial.

During the period when reservoirs such as the Thermalito Afterbay are thermally stratified (April through November), coldwater fish reside primarily within the metalimnion and hypolimnion where water temperatures remain suitable. Reduced reservoir storage during this period could reduce the reservoir's coldwater pool volume, thereby reducing the quantity of habitat available to coldwater fish species during these months. Reservoir coldwater pool size generally decreases as reservoir storage decreases, although not always in direct proportion to the storage decrease because of the influence of reservoir basin morphometry. Therefore, to assess potential storage-related impacts to coldwater fish habitat availability in thermally stratified lentic water bodies, the amount of cold water available will be assessed using data from thermal profiles obtained ~~by~~ in SP-W6. This analysis will include a temporal component because water temperature data will be taken at 15 minute intervals over the course of SP-W6 data collection. Therefore it will be possible to characterize the cold water pool availability year-round in the Thermalito Afterbay to determine whether or not the Thermalito Afterbay has sufficient cold water to support a year-round coldwater fishery. The cold water pool will be quantified on a monthly basis for each month of the year. Temperature readings from each sensor/profile will be used to calculate monthly average temperature at each depth interval and will be applied to the area and volume represented by each sensor/profile to estimate the cold water pool in the Thermalito Afterbay. The area and volume associated with each thermistor will be determined using topographic maps and any existing reservoir bathymetry data. During warm months when thermal stratification may play a larger role in determining cold water pool availability, the characterization of cold water pool availability may occur on a shorter time-step, such as biweekly, by calculating average biweekly water temperatures from SP-W6 water temperature data, depending on the amount of heterogeneity observed in the water temperature profile data from week to week. A final report detailing the findings of Task 4B will be completed three months following completion of the first year of data collection by SP-W6. The estimations of the amount of cold water in the Thermalito Afterbay for each month will be used to determine the feasibility of a year-round salmonid fishery in this reservoir during evaluations development of potential PM&Es.

Task 4C-Characterize Inundated Littoral Habitat and Evaluate Effects of Fluctuations on Bass Nest Dewatering

Characterization of inundated littoral habitat. The objective of this portion of Task 4C is to estimate the relationship between water surface elevation and acres of nearshore littoral habitat in the Thermalito Afterbay. Inundated vegetation is an important habitat component for warmwater fish because it is associated with the strength of year-class recruitment to the subsequent year-class. Additionally, inundated vegetation provides juveniles escape cover that protects them from predation. A relationship between Thermalito Afterbay water surface elevation and acres of nearshore littoral habitat containing submerged macrophytes and/or inundated terrestrial vegetation will be developed using data gathered in SP-T4. SP-T4 will provide maps of the submerged aquatic vegetation and emergent aquatic vegetation constructed using aerial photograph interpretation and will provide maps of all aquatic vegetation patches greater than 1/10th of an acre in the Thermalito Afterbay. Additionally, SP-T4 will provide maps of the inundated vegetation occurring in the Thermalito Afterbay and will provide estimates of the mean number of acres of inundated littoral habitat. Using the SP-T4 vegetation maps and topographical maps, the amount of vegetation that is inundated at various reservoir levels will be estimated. The reservoir levels for which the amount of inundated vegetation is estimated will be determined by a review of project operations records, as described below.

The potential effects of project operations on the available inundated littoral habitat will be estimated by comparing DWR operations reports, including reservoir storage information, to the amount of inundated littoral habitat at various reservoir levels. For example, reports describing the reservoir fluctuation that occur during pumpback will be used to determine the water surface elevation changes during pumpback. These reservoir levels can be used for calculation of the change in amount of inundated vegetation (using SP-T4 vegetation maps and topographical maps), thereby allowing an assessment of the effects of pumpback operations on the amount of inundated littoral habitat. Estimates for different operational scenarios (pumpback, weekly power generation fluctuations, etc.) will be made in order to predict the effect of changes in water surface elevation on the amount of available habitat. Additionally, operations reports will be reviewed, and a description of trends in operations on a seasonal basis (spring, summer, etc.) will be generated. For example, pumpback operations may occur more frequently during some seasons than others. Seasonal trends in operations will be compared to lifestage and habitat requirements of bass species in the Thermalito Afterbay. For example, if a given operational scenario results in frequent changes in the amount of inundated littoral habitat, the potential impact to the Thermalito Afterbay bass population would depend, in part, on whether or not the frequent fluctuations were occurring at a time of year in which bass lifestage information suggested that inundated littoral habitat was an important habitat component. Seasonal trends in operations will be summarized and compared to the lifestage characteristics to provide a narrative evaluation of the potential effects of operations on available littoral habitat and the bass population.

Evaluation of effects of water surface level fluctuations on bass nest dewatering. The objective of this portion of Task 2C is to estimate the ratio of bass nests subject to dewatering in the Thermalito Afterbay. Snorkel surveys will be conducted to determine depths at which bass spawn in the Thermalito Afterbay. The snorkeling survey sites will be based on a stratified sampling regime. The stratification will be based on gross differences in habitats within the Thermalito Afterbay including slope, gross substrate classes (rip-rap versus pea-gravel), water depth, and water temperature (from SP-W6). Snorkel divers will snorkel the same areas under several reservoir conditions during the spawning season (April - ~~September~~ June 2003)~~ including conditions near full pool, near minimum pool, and one intermediate condition~~. Frequency and exact timing of snorkel surveys will be based partially on reservoir conditions such as wind, fluctuation rate, and water clarity. At each snorkel site bass nests will be counted and their depth and location recorded. Nest elevation will be determined by measuring depth from the surface at a known water surface elevation. Using survey results, the percentage of bass nests dewatered by changing the reservoir level from full pool to near minimum pool (or to the intermediate condition) can be estimated. The percentage of nests dewatered can be calculated for a change in reservoir elevation from any of the water surface elevations surveyed to any lower reservoir water surface elevation surveyed. As discussed in Task 2B, nest survival criteria developed by DFG suggests that on average, a nest survival rate of at least 20 percent is necessary to maintain the long-term population levels of high-fecundity, warmwater fish (D. Lee, pers. comm. 1998). Using the water-~~surface~~bass nest elevations surveyed, reservoir fluctuations will be ~~evaluated~~ analyzed for nest survival and evaluated against the ~~whether or not~~ 20 percent bass nest survival rate target~~s could be expected to survive during changes in water surface elevations~~. A final report detailing the findings of Task 4C will be completed by November 2003.

Task 5—Describe F~~f~~ish ~~s~~Species ~~c~~Composition and ~~c~~Characterize ~~h~~Habitat in the Oroville Wildlife Area ponds

The Oroville Wildlife Area contains over 75 warmwater ponds and sloughs, along with vast complexes of emergent marsh and flooded cottonwood, willow, and sycamore trees. It provides habitat for largemouth bass, bluegill, green sunfish, carp, black and white crappie, and channel and white catfish. Due to the water temperatures in the OWA ponds, the ponds primarily provide habitat for warmwater fish.

The OWA ponds are a dynamic environment influenced by rainwater and river stage. Some ponds are permanently inundated, while others are seasonal ponds. Levees along the Feather River keep most water from the main channel from entering the OWA, except during high water events when Lake Oroville spills. During these events, water from the main river channel spills over low spots in the levees, flooding large areas of the OWA for a period of time. This is a flood control mechanism that disperses some of the high flows moving down the main channel of the Feather River. Other than these high water events, OWA ponds are replenished by rainwater and underground seepage from the water table, which is strongly affected by the stage of the Feather River. Therefore, water levels in OWA ponds fluctuate with changes in the amount of rain, the river stage, and the level of the water table. Large areas of the OWA will seasonally flood during the winter and spring, and dry up during the late summer and fall with the lowering water table and river stage. The lowest elevation areas, such as the pits dug during historic dredging operations, will remain flooded year-round, forming the permanent ponds that are common throughout the OWA. A significant habitat change has been occurring in the southeastern section of the OWA, representing about 1/3 of the total OWA acreage. Following a breach in the levee at approximately River Mile 60 that occurred during the 1997 floods, repairs were conducted that resulted in a small flow of water passing under the base of the levee and into the OWA on a continuous basis. Beaver dams have been constructed on this flow as it passes through the OWA, and large areas of the southeast section of the OWA are now flooded on a continuous basis, and are no longer subject to the fluctuation effects of the river stage and water table. Due to this lack of water level fluctuation, aquatic vegetation encroachment has occurred. The increased plant growth in the OWA continues to decrease the amount of habitat suitable for foraging adult fish, and this condition is increasing.

The objectives of Task 5 are to describe the fish species composition (Task 5A) and to characterize fish habitat, focusing on aquatic weed encroachment and water temperature (Task 5B), with the goal of providing baseline in formation which will serve as a foundation for future evaluations and ~~the~~ development ~~and evaluation~~ of potential ~~future~~ PM&Es.

Task 5A-Describe Fish Species Composition in One-mile pond

The field studies and analytical techniques proposed for the OWA focus on collecting baseline information to serve as a foundation for future evaluations and development of future potential PM&Es designed to continue to provide an attractive fishery in the OWA ponds. Existing creel data for OWA ponds is not expected to provide sufficient information to describe the fish species composition in OWA ponds. However, data from the creel survey conducted in SP-R13 may provide information regarding fish species composition. Therefore, additional field studies are necessary to provide species composition data and fish metrics data. As described earlier in Task 4A, DFG will add an OWA pond to its electroshocking rotation, using the methods described for electroshocking the Thermalito Afterbay. One-mile pond has been chosen as the electrofishing sample pond for the reasons described below.

One-mile pond has been chosen as the electroshocking sampling pond for the OWA for several reasons. One-mile pond is a large pond that contains a variety of habitat types that represent other fish bearing ponds of the OWA, such as cobbled bottom and shoreline, seasonally flooded terrestrial vegetation such as willow and cottonwood, large beds of submerged aquatic vegetation, and emergent marsh habitat. Therefore, One-mile pond is expected to represent the range of fish and habitat diversity and complexity found throughout the OWA ponds. Additionally, there are fish in One-mile pond year-round. The water level fluctuates in One-mile pond fluctuates with changes in river stage, making One-mile pond an OWA pond which is influenced directly by project operations. Under high flow conditions, One-mile pond is connected to other ponds in the OWA and fish can move freely between the ponds under these conditions. One-mile pond will be sampled for water quality parameters and has been chosen, in part, to maintain consistency with work being conducted by water quality plans. In addition, there is an existing boat ramp allowing access for an electroshocking boat.

As described in Task 4A, electroshocking will take place over one day in the spring and one day in the fall, and the objective of the electroshocking is to determine fish species composition in One-mile pond. Species information recorded during electroshocking sampling will include the number of fish of each species and fish metrics, including length and weight. Results of electroshocking will be recorded by location or habitat type, as described in Task 4A. If necessary, additional suitable sampling methods, such as boat seining, may also be employed to determine species composition and fish metrics in One-mile pond. Although existing data is not expected to provide sufficient information to document species composition, any relevant existing information describing fish species composition in the OWA ponds will be included in this description. Additionally, any available data describing the relative abundance and distribution of fish species of primary management concern, including data from electroshocking sampling or boat seines, will be incorporated when possible. As with other tasks, if there are fish species of primary management concern in One-mile pond whose life history characteristics and habitat requirements have not been summarized previously, this information will be reviewed and compiled as part of Task 5A, as described in Task 1B above. A final report summarizing the findings of Task 5A will be completed three months following the completion of the fish sampling (electroshocking and/or additional methods) and fish metrics data collection.

Task 5B-Characterize Fish Habitat in One-mile pond

The objective of Task 5B is to collect baseline habitat characterization information to serve as a foundation for future evaluations and development of ~~future~~ potential PM&Es designed to continue to provide an attractive fishery in the OWA ponds. Potential PM&E suggestions may include development and implementation of measures designed to reduce aquatic weed encroachment. Characterization of the existing habitat conditions is necessary to provide the tools needed for future evaluations and to evaluate future development of potential PM&Es.

Excess growth of aquatic vegetation has the potential to decrease forage efficiency and reduce abundance of warmwater fish due to hypoxia (Miranda and Hodges 2000). For example, in a study assessing sunfish abundance, both scarce aquatic vegetation and extensive aquatic vegetation resulted in low sunfish abundance, while intermediate vegetation coverage resulted in greater fish abundance (Miranda and Hodges 2000). For this reason, SP-T4 will provide maps of the submerged aquatic vegetation and emergent aquatic vegetation in the OWA. ~~SP-T4 will use a~~Aerial photograph interpretation will be used in SP-T4 to map all aquatic vegetation patches greater than 1/10th of an acre in OWA ponds, including One-mile pond. From the aquatic vegetation map, SP-T4 will provide calculations of~~e~~ the percentage of the surface area of the ponds which are covered by aquatic vegetation. Additionally, SP-T4 will provide estimates of the density of the cover in OWA ponds using visual assessment and a percentage estimation scale during field surveys. The percentage estimation scale for the density estimation will be determined by literature review (see below), but may include categories such as 0- 50% coverage, 50-90% coverage, and 90%-100% coverage. The scale will be designed such that the upper most classification represents a density range that inhibits fish utilization (to be determined from literature review). Additionally, in order to characterize the habitat, SP-T4 will provide estimates of the extent of the littoral zone as a percentage of the total water body area.

In addition to mapping the submerged and emergent aquatic vegetation, a literature review will be conducted in this task to compile information regarding the effects of the density of aquatic vegetation on forage efficiency, dissolved oxygen concentrations, and fish abundance. The literature review will provide information regarding the relationship between aquatic vegetation density and warmwater fish abundance. The literature review will also summarize the results of studies comparing aquatic vegetation density to fish abundance to estimate the upper threshold of aquatic vegetation density that can be utilized by warmwater fish. From the compiled information, the scale for estimating aquatic vegetation density will be constructed and given to SP-T4 for estimation of aquatic vegetation density in mapped patches of vegetation. Because the literature review will furnish the cover density estimation scale and therefore needs to be completed prior to field surveys ~~done~~ conducted by SP-T4 in the OWA ponds, the literature review will be completed within three months of study plan approval.

Water temperature information will be obtained from SP-W6. In SP-W6, ~~will take~~ water temperature profiles will be taken monthly during the winter and biweekly from spring to fall in 4 OWA ponds, including One-mile pond. Temperature profiles will be measured at half to one-meter intervals from the surface to the bottom using a thermistor. Additionally, once during the warmest portion of the summer (late summer or early fall), dissolved oxygen concentrations will be measured ~~by~~ in SP-W1 to investigate diel differences in dissolved oxygen concentration due to photosynthesis by aquatic vegetation. Dissolved oxygen concentrations will be measured vertically each meter using membrane electrode probes in One-mile pond. Measurements will occur once during the warmest part of the day (late afternoon) and once during the coolest part of the day (early morning) to investigate whether or not there is diel flux in the dissolved oxygen concentration. During electroshocking of One-mile pond (Task 5A), fisheries biologists will provide a general characterization of the substrate types present in the pond for use in describing the habitat conditions. A final report describing the findings of Task 5B will be completed three months following the completion of first year of data collection in supporting FERC plans.

6.0 Results and Products/Deliverables

Results

Results will be organized following the task headings. Each task will include a narrative of the relevant findings as well as tables, figures and maps summarizing the key points. The anticipated maps, graphical representation of reviewed data (e.g., charts, and graphs), and summary figures and tables include:

- Summary of literature review describing existing information which previously identified the extent of upstream migration of salmon into Lake Oroville's upstream tributaries, summary of literature review describing sized-based passage criteria for inland-sized salmon, reservoir-sized salmon, and sturgeon; narratives, videos, and pictures documenting conditions at potential upstream migration barriers above Lake Oroville's high water mark on each named tributary; narrative describing the identification of upstream migration barriers above Lake Oroville's high water mark on each named tributary; data from SP-G1 used in analysis of passability of sediment plugs within the fluctuation zone of Lake Oroville; narratives, pictures, and videos documenting conditions at potential upstream migration barriers within the fluctuation zone of Lake Oroville; sediment plug stability analysis by SP-G1; and a narrative describing the identification of upstream migration barriers within the fluctuation zone of Lake Oroville (Task 1A);
- Summary of literature review describing fish species composition in Lake Oroville's upstream tributaries; tables or figures illustrating data resulting f~~o~~rom snorkel surveys and electroshocking; and summary of life history characteristics and habitat requirements for fish of primary management concern for which this information has not yet been documented, if necessary (Task 1B);
- GIS coverages of habitat components for Lake Oroville's upstream tributaries of 2nd order or larger; GIS coverages of habitat distribution by species, species guild and/or lifestage for surveyed tributaries (Task 1C);
- Table, figure, or narrative summary of literature review describing fish species composition in Lake Oroville; table, figure, or narrative describing data extraction (data mining) methods and results of analysis of previously collected data (if required); summary of any data describing relative abundance and distribution of fish in Lake Oroville; and summary of life history characteristics and habitat requirements for fish of primary management concern for which this information has not yet been documented, if necessary (Task 2A);
- Exceedance curves produced by SP-E7; the calculated volume of cold water available per fish; the results of the literature review including recommended loading densities; the comparison of recommended loading densities to the calculated volume of cold water available per fish; and conclusions regarding the ability of Lake Oroville's cold water pool to support salmonid stocking recommendations (Task 2B);
- Daily average water surface elevation fluctuations from April through September in dry, normal, and wet years; surface waterwater surface elevation reduction criteria providing greater than 20% survival by applying DFG nest survival curves to Lake Oroville storage-elevation relationships; and comparison of the actual fluctuations resulting from project operations in dry, normal, and wet years to the fluctuation criteria which would provide greater than 20% nest survival (Task 2C);

- Summary of management policies, monitoring studies, and progress reports regarding management of large reservoirs for sturgeon (Task 2D);
- Summary of existing creel survey data, electrofishing data, trapnetting data, gill netting data, and stocking reports used in describing fish species composition in the Thermalito Diversion Pool and Thermalito Forebay; and summary of life history characteristics and habitat requirements for fish of primary management concern for which this information has not yet been documented, if necessary (Task 3A);
- Summary of data describing habitat conditions in the Thermalito Diversion Pool and Thermalito Forebay including physical reservoir characteristics, water temperature data, water quality data, and vegetation mapping (Task 3B);
- Description of project operations which influence habitat conditions in the Thermalito Diversion Pool and Thermalito Forebay using existing operations reports and guidelines; relevant dat a describing water temperatures during pumpback and power generation operations (Task 3C);
- Fish species composition data and a narrative description of fish species composition; data and descriptions of relative abundance and distribution of fish of primary management concern (as available); YAR calculations for bass in the Thermalito Afterbay; a comparison of YAR for bass in the Thermalito Afterbay to the YAR for bass in other reservoirs managed for warmwater fisheries; and summary of life history characteristics and habitat requirements for fish of primary management concern for which this information has not yet been documented, if necessary (Task 4A);
- Water temperature data for the Thermalito Afterbay from SP-W6; calculations detailing the area and volume represented by each sensor or profile; and calculations estimating the cold water pool volume on a monthly basis (possibly more frequently) (Task 4B);
- Vegetation maps generated by SP-T4; topographical maps; summary of reservoir operations records describing the change in reservoir levels during pumpback and power generation; calculation of the amount of inundated vegetation occurring at relevant water surface elevations; estimates of the amount of change in inundated littoral habitat during pumpback and power generation; a summary of seasonal trends in operations; a comparison of the seasonal trends in operations and change in littoral habitat during those operations to the lifestage requirements of bass; description of the stratified sampling design used for snorkel surveys; snorkel survey results; calculations describing the percentage nests dewatered during water surface elevation fluctuations from full pool to intermediate pool and to near minimum pool; and evaluation of the effect of changes in water surface elevation on bass nesting in the Thermalito Afterbay. (Task 4C);
- Fish species composition data and a narrative description of fish species composition; and data and descriptions of relative abundance and distribution of fish of primary management concern (as available) (Task 5A); and
- Aquatic vegetation maps from SP-T4; summary of the information compiled in the literature review; water temperature and dissolved oxygen data from SP-W6; and narrative description of the existing habitat conditions~~;~~ (Task 5B).

Products/Deliverables

The study plan summary report will include:

- Executive Summary

- Table of Contents
- List of Tables
- List of Figures
- Introduction
- Methodology
- Narratives of relevant findings by task
- Discussion addressing most relevant questions (see above) and indicating any complications/data concerns
- Conclusions related to study plan goals and objectives
- References
- Appendices

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

Completion of this study plan will require information from other resource study plans being prepared for the Oroville Facilities FERC Relicensing Project including engineering and operations, geomorphology, water quality, terrestrial, and other fisheries study plans. Coordination among study plans is currently underway to ensure consistency and efficiency in obtaining needed information. A preliminary list of study plans that will ~~be~~ require coordination with this study plan include:

- SP-F2—Effects of Project Operations on Fish Diseases

SP-F3.1 will provide information to SP-F2 regarding fish species composition data, relative distribution (when possible), life history characteristics, and habitat conditions in the study area.

- SP-F3.2-Evaluation of Project Effects on Non-salmonid Fish in the Feather River Downstream of the Thermalito Diversion Dam

Task 2 of SP-F3.2 will provide SP-F3.1 with life history and habitat requirements for fish in the Feather River downstream of the Thermalito Diversion Dam for use in similar tasks (Tasks 1B, 2A, 3A, 4A, and 5A) in SP-F3.1.

- SP-F5/7—Effects of Fisheries Management on Project Fisheries

SP-F3.1 will provide information regarding fish species composition, relative fish distribution (when possible), existing habitat conditions, and potential PM&E measures to SP-F5 for an evaluation of stocking and non-stocking fisheries management activities with respect to the Endangered Species Act (Task 1 of SP-F5) and for a description of the interactions of managed reservoir fisheries and riverine fisheries in the study area

(Task 3 of SP-F5). Task 2 of SP-F5 will provide the number of fish required to meet stocking goals to Task 2B of SP-F3.1.

- SP-F8-Transfer of Energy and Nutrients by Anadromous Fish Migrations

Task 1A of SP-F3.1 will provide Task 2 of SP-F8 with the identification of upstream passage barriers in above Lake Oroville's high water mark in the upstream tributaries which will be used to define the study area of SP-F8. Additionally, Task 1C of SP-F3.1 will provide characterization of existing fish habitat in Lake Oroville's upstream tributaries for use in estimating the potential maximum escapement of chinook salmon in Task 2 of SP-F8.

- SP-F10-Evaluation of Project Effects on Anadromous Salmonids and their Habitat

Snorkel survey methodology described in Task 3A of SP-F10 will be adopted for use in Task 1B of SP-F3.1. Additionally, literature reviews undertaken in SP-F10 describing habitat requirements and life history characteristics will be utilized by similar tasks (Tasks 1B, 2A, 3A, 4A, and 5A) in SP-F3.1.

- SP-G1—Effects of Project Operations on Geomorphic Processes Upstream of Oroville Dam

In order to maximize cost-effectiveness, SP-G1 will provide SP-F3.1 with required geomorphic information for Lake Oroville's upstream tributaries named in section 4.0 Study Areas. Fieldwork completed in plan SP-G1 will support identification of upstream migration barriers within the fluctuation zone of Lake Oroville (Task 1A) and habitat characterization efforts (Task 1C) in SP-F3.1. Specific information and methodologies for obtaining these data to fulfill fisheries needs are given below.

Data obtained from SP-G1 for the purpose of identification of upstream migration barriers within the fluctuation zone of Lake Oroville (Task 1A of SP-F3.1) will include mapping of channel resources and sediment plug stability analysis. Channel resources in the tributaries above Oroville Dam will be mapped using a combination of cross-sectional surveys, sonar and GPS. SP-G1 will provide SP-F3.1 with the reservoir level (water surface elevation) at which each major sediment plug becomes exposed. Additionally, SP-G1 will provide either cross-sectional data or a sonar-generated image that will describe the shape and character of the sediment plug. Task 4 of SP-G1 will also perform cross-sectional monitoring at representative high, medium, and low flows to be used in identification of upstream migration barriers within the fluctuation zone. Task 5 of SP-G1 will provide an analysis of sediment plug stability which will include the temporal stability of the sediment plugs, the relationship of sediment plug stability to tributary flows, the relationship of sediment plug stability/longevity to the frequency of inundation/location within the fluctuation zone, the likelihood of sediment plug transport, the relationship between sediment plug formation and total sediment load in the tributary, and the relationship between sediment plug formation and changes in the water surface elevation of Lake Oroville.

Data obtained from SP-G1 for the purpose of habitat characterization (Task 1C of SP-F3.1) will include measurements of geomorphic parameters, substrate characterization, and assessment of woody debris and cover and mesohabitat mapping. Geomorphic parameters including channel width, depth, cross-section, hydraulic radius, and roughness will be collected as specified in SP-G1. Substrate will be characterized in each habitat type occurring at each cross-section using both the Wolman pebble count method and gravel sieving as specified in Tasks 2 and 3 of SP-G1. Substrate characterization will include particle size down to 0.1 mm in diameter. Following substrate characterization, gradation curves will be produced by SP-G1. These curves will illustrate the grain-size cumulative and percent distribution and will be useful for assessing the suitability of spawning habitat.

Spawning gravel quality will be visually assessed to describe gravel shape and embeddedness using the method used by SCE during relicensing of the Big Creek Hydroelectric Facilities. This assessment will occur during Wolman sampling and gravel sieving (Task 2 and 3, SP-G1). The quality of spawning gravel will be determined based on both angularity and embeddedness. Gravel of high spawning suitability is highly rounded, with little sand and fines and low embeddedness. Spawning gravel is considered of low quality if it is angular or if it is highly embedded with a high proportion of sand, regardless of angularity. The scoring criteria for spawning gravel quality are listed below:

Spawning Quality Rating	**Description of Substrate**
Excellent	Round-shaped spawning gravels loose in substrate.
Good	Round-shaped spawning gravels slightly embedded in substrate *or* moderately jagged-shaped spawning gravels loose in substrate.
Fair	Round-shaped spawning gravels embedded in substrate *or* moderately jagged-shaped spawning gravels slightly embedded in substrate.
Poor	Round-shaped *or* jagged-shaped spawning gravels deeply embedded in substrate.

Cover will be assessed by SP-G1 using a classification system currently in use by DWR. This cover classification system is described below:

Cover code	**Cover description**
A	No apparent cover
B	Small to medium instream objects/woody debris (<31 cm or 1 ft. in diameter)
C	Large instream objects/woody debris (>31 cm or 1 ft. in diameter)
D	Overhead objects
E	Submerged aquatic vegetation
F	Undercut bank

The dominant cover type will be noted. Additionally, if the dominant cover type is large instream woody debris (Code C), the number of total pieces of wood in or intersecting the active stream channel will be counted and recorded. Wood will be counted if greater than one-third of the length of each piece of wood is situated within the stream channel. Each piece of wood satisfying these criteria found in debris jams will be counted and recorded.

SP-F3.1 will obtain mesohabitat characterization data from Task 2 of SP-G1 for the identified upstream tributaries to the first migration barriers (defined in Task 1A). Habitat characterization will be conducted using the following habitat characterization scheme, which includes designating habitat as riffle, run, pool, glide, and backwater based on gradient, substrate size, water velocity, depth, and turbulence. The table below lists the DWR criteria currently used on the Feather River below Oroville Dam to define each habitat unit:

Habitat Unit	Defining Characteristics
Riffle	Typically shallow reaches with swiftly flowing, turbulent water; sometimes have partially exposed substrate, typically composed of cobble; small, breaking surface waves are a good indicator of riffles
Run	Swift flowing reaches with little surface agitation and no major flow obstructions; may appears as flooded riffles; similar to glides but shallower and with less uniform bottoms surface; typical substrate consists of gravel, cobble, and boulders
Pool	Relatively deep with fine-grained substrates; relatively low gradient with relatively low water velocities; tranquil; section controlled.
Glide	Uniform channel bottoms with moderate to low flow velocities and little turbulence; substrate is variable; swift flowing but less turbulent and deeper than riffles; deeper and more uniform bottom than runs
Backwater	Pools formed outside or at the margins of the main channel; exhibit little to no flow velocity; often elongate with long axis parallel to the main river channel. but lacking flow input to the upstream end of the backwater; water inside the backwater pools is effectively dammed by adjacent main channel water; usually deepest at the point closest to main channel flow; substrate usually consists of fines

Although cascades are not found in the Feather River below Oroville Dam and are therefore not described above, they may be found in steeper upstream tributary reaches. The habitat typing characterization scheme described above defines cascades as very steep riffle habitats, consisting of alternating small waterfalls and shallow pools, generally with bedrock or boulder substrate. If cascades are present in Lake Oroville's upstream tributaries, this category will be utilized.

Mesohabitat units will be mapped on areal photographs using a combination of areal photographic delineation and groundtruthing during field survey activities in Lake Oroville's upstream tributaries. If possible, mesohabitat units will either be delineated on an orthorectified photographic base prepared by the GIS group or on an areal photograph which can be registered onto the orthophotographic base. The mesohabitat maps will be used in Task 1C of SP-F3.1 and will also be used for the estimation of available spawning habitat (i.e, riffles) in Task 2 of SP-F8.

- SP-W1—Project Effects on Designated Beneficial Uses

SP-W1 will provide measurements of water quality parameters such as dissolved oxygen, conductivity, pH, and temperature as specified in Task 1 of SP-W1 for use in construction of habitat maps in Task 1C of SP-F3.1. Additionally, Task 2 of SP-W1 will also compare water quality conditions to criteria established for freshwater aquatic life and will report exceedances of these criteria to Task 1C of SP-F3.1 for use in construction of habitat maps. SP-W1 will also provide Task 3B of SP-F3.1 with water quality data to be used in describing the existing habitat in the Thermalito Diversion Pool and Thermalito Forebay. In One-mile pond in the OWA (Task 5B of SP-F3.1), dissolved oxygen concentrations will be measured by SP-W1 to investigate diel differences in dissolved oxygen concentration due to photosynthesis by aquatic vegetation. Dissolved oxygen concentrations will be measured vertically each meter using membrane electrode probes in One-mile pond. Measurements will occur once during the warmest part of the day (late afternoon) and once during the coolest part of the day (early morning) to investigate whether or not there is diel flux in the dissolved oxygen concentration. Measurements will be taken during the warmest portion of the summer (late summer or early fall).

- SP-W2-Contaminant Accumulation in Fish, Sediments, and the Aquat ic Food Chain

Phase 1 of SP-W2 will involve gill netting in the Thermalito Diversion Pool to obtain tissues samples for contaminant analysis. Relevant data collected regarding fish species composition will be reported to Task 3A of SP-F3.1.

- SP-W6—Project Effects on Temperature Regime

SP-W6 will provide water temperature data from sampling stations in Lake Oroville's upstream tributaries as described in Task 1A of SP-W6 to Task 1C of SP-F3.1 for use in construction of habitat maps. SP-W6 will also provide Task 3B of SP-F3.1 with water temperature data to be used in describing the existing habitat in the Thermalito Diversion Pool and Thermalito Forebay and in determining the water temperature resulting from power generation and pumpback operations in Task 2C of SP-F3.1. Task 4B of SP-F3.1 will utilize water temperature data collected by SP-W6 for characterization of the cold water pool available in the Thermalito Afterbay. For Task 5B of SP-F3.1, SP-W6 will take water temperature profiles monthly during the winter and biweekly from spring to fall in 4 OWA ponds, including One-mile pond. Temperature profiles will be measured at half to one-meter intervals from the surface to the bottom using a thermistor.

- SP-T4-Biodiversity

SP-T4 (Tasks 3, 6, and 7) will provide vegetation maps including wildlife habitat relationships distilled into four general classes: trees, brush, grass, and shrub in the study area for integration into habitat maps in Task 1C of SP-F3.1. SP-T4 will also provide Task 3B of SP-F3.1 with vegetation mapping data to be used in describing the existing habitat in the Thermalito Diversion Pool and Thermalito Forebay. SP-T4 will also map the submerged aquatic vegetation and emergent aquatic vegetation in the Thermalito Afterbay (Task 4C of SP-F3.1) using aerial photograph interpretation SP-T4 will map all aquatic vegetation patches greater than 1/10th of an acre in the Thermalito Afterbay. Additionally, SP-T4 will map the inundated vegetation occurring in the Thermalito Afterbay and will estimate the mean number of acres of inundated littoral habitat for use in Task 4C of SP-F3.1. In order to characterize fish habitat in One-mile pond in the OWA (Task 5B of SP-F.1), SP-T4 will map the submerged aquatic vegetation and emergent aquatic vegetation in the OWA. SP-T4 will use aerial photograph interpretation to map all aquatic vegetation patches greater than 1/10th of an acre in OWA ponds, including One-mile pond. From the aquatic vegetation map, SP-T4 will calculate the percentage of the surface area of the ponds which are covered by aquatic vegetation. Additionally, SP-T4 will estimate the density of the cover in OWA ponds using visual assessment and a percentage estimation scale during field surveys and will estimate the extent of the littoral zone as a percentage of the total water body area.

- SP-R13-Recreation Surveys

Results of the creel survey conducted by SP-R13 will be used to help determine fish species composition and relative distribution (when possible) in Tasks 1B, 2A, 3A, 4A, and 5A of SP-F3.1.

Engineering and Operations Work Group Studies and Models

- SP-E7-Oroville Reservoir Cold Water Pool Evaluation

SP-E7 will provide exceedance graphs estimating the probability that there will be a certain volume of water below a certain temperature on a monthly basis for Lake Oroville for use in estimating cold water pool availability in Task 2B of SP-F3.1.

- SP-E8-Temperature Impacts of Pumpback Operation on Oroville Reservoir Cold Water Pool

Task 3C of SP-F3.1 will utilize any relevant data collected by Task 3 of SP-E8 regarding water temperatures in the Thermalito Diversion Pool and Thermalito Forebay during pumpback operations.

Maps Produced by DWR GIS Group

DWR GIS group will aid in assembling habitat maps using data collected from SP-G1, as specified in section Task 1C of study plan SP-F3.1.

Stakeholder Issue ~~Statement~~s Partially Addressed by this Study Plan

Issue	Description
FE3	Is the present minimum pool adequate for protecting The Lake Oroville cold-water sport fishery; also addressed in SP-E7
FE8	Lake Oroville releases made for power generation may cause dramatic fluctuations in lake level. What are the potential impacts of fluctuation zone and surface elevation change on recreation opportunities and on fish and wildlife habitat?; also addressed in SP-R3
FE12	Protect and improve wild trout habitat; also addressed in SP-F3.2
FE57	Provide habitat leading to viable populations of endangered species. Maintain habitat to support viable populations of all native and desired nonnative vertebrate species; also addressed in SP-F10 and SP-F3.2
FE58	Improve and protect habitat for designated emphasis and harvest species. Identify and evaluate potential conflicts among project effects and management actions for protected and sensitive species; also addressed in SP-F5 and SP-F3.2
FE59	Protect and improve habitat for trout; also addressed in SP-F3.2
FE81	Currently some of the species of fish commonly found in Lake Oroville are also found in the Poe reach of the North Fork Feather River. Maximum water temperatures in the Poe reach often exceed 20 C (68 F), making management of the Poe reach as a coldwater fishery difficult. There is an interest in determining the interaction of the Lake Oroville fishery with the Poe reach fishery, and identifying measures that can be taken to maintain the Poe reach as a coldwater fishery; also addressed in SP-F5 and cumulative analysis

Source: NEPA Scoping Document 1 and CEQA Notice of Preparation, DWR 2001.

Stakeholder Issue ~~Statement~~s Fully Addressed by this Study Plan

Issue	Description
FE1	Are the project related Lake Oroville water level fluctuations presently affecting the reproduction and survival of warm-water sportfish?
FE2	How will the project related Lake Oroville water level fluctuations affect the reproduction and survival of warm-water sportfish under future operational demands?
FE52	Facility operations and impact on bass fishery and spawning activities at Afterbay (protect and enhance bass fishery).
FE64	Effect of project on available upstream fishery habitat (Incorporate all project facilities).

Source: NEPA Scoping Document 1 and CEQA Notice of Preparation, DWR 2001.

8.0 Study Schedule

	Timing/Deadlines		
Task	**Field data collection/analysis occurring in SP-F3.1**	**Interim Report**	**Final Report**
1A	Literature review	August 2003	3 months following completion of SP-G1 data collection and sediment stability analysis
	Identification of upstream migration barriers above the high water mark of Lake Oroville (fall 2002 and spring 2003)		
	Identification of upstream migration barriers within the fluctuation zone of Lake Oroville (fall 2002), including sediment stability analysis provided by SP-G1	N/A	
1B	Literature review Snorkel surveys for determination of fish distribution (fall 2002 and spring 2003), including summary of life history characteristics and habitat requirements (if required)	N/A	August 2003
1C	GIS coverages of each habitat component using data supplied by supporting FERC plans	December 2002	3 months following the completion of the first year of data collection in the supporting FERC plans
	GIS coverages of habitat distribution by species for 4 surveyed tributaries and comparison of GIS coverages to fish distribution data	December 2002	
2A	Literature review	N/A	June 2003
2B	Evaluation of the ability of Lake Oroville's cold water pool to support salmonid stocking recommendations	N/A	3 months following the completion of SP-E7
2C	Evaluation of the effects of water surface elevation fluctuations on bass nest dewatering	N/A	November 2002
2D	Review and summary of management practices and results of monitoring studies in reservoirs actively managed for sturgeon	N/A	November 2002
3A	Review of existing information including creel survey data to document fish species composition, including a summary of life history and habitat characteristics (if required)	N/A	June 2003
3B	Review of existing habitat conditions	N/A	3 months following completion of the first year of data collection in supporting FERC plans
3C	Description of project operations influencing the Thermalito Diversion Pool and Thermalito Forebay	N/A	3 months following completion of required data collection in SP-E8 and SP-W6

4A	Electroshocking and/or boat seining surveys to obtain fish species composition data (fall and spring)	N/A	3 months following the completion of the fish sampling, collection of fish metrics data, and creel survey data collection from SP-R13
4B	Characterization of cold water pool availability in the Thermalito Afterbay	N/A	3 months following completion of the first year of data collection by SP-W6
4C	Characterization of inundated littoral habitat	N/A	November 2003
	Snorkel surveys (April-September 2003)		
5A	Electroshocking and/or boat seining surveys to obtain fish species composition data (fall and spring)	N/A	3 months following the completion of the fish sampling, collection of fish metrics data, and creel survey data collection from SP-R13
5B	Literature review	3 months following study plan approval	3 months following completion of the first year of data collection in supporting FERC plans
	Characterization of fish habitat	N/A	

9.0 References

A complete list of references used in the completion of the study will be part of the summary report. The references cited in the present plan are listed below.

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